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September 10, 1992

Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Re: Advanced Television Systems
FCC MM Docket No. 87-268
Ex parte presentation of Future Images Today (FIT)

Sirs:

In accordance with Rule 1.1206, enclosed for inclusion in the above docket are two copies of an ex parte presentation made by FIT to the Commission's Office of Engineering and Technology, beginning at 3:27 P.M. on September 10, 1992.

Kindly date stamp the enclosed conforming copy and return it to our office in the attached envelope.

Respectfully submitted,

Leo Zucker, Attorney
Future Images Today

encs.
cc: Ray Kowalski, Esq.
Keller and Heckman

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FEDERAL COMMUNICATIONS COMMISSION
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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of

Advanced Television Systems and Their Impact on the Existing Television Broadcast Service	)
Review of Technical and Operational Requirements: Part 73-E, Television Broadcast Stations	) MM Docket No. 87-268
Reevaluation of the UHF Television Channel and Distance Separation Requirements of Part 73 of the Commission's Rules	)

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TO: The Commission

<u>EX PARTE PRESENTATION TO OFFICE OF ENGINEERING AND TECHNOLOGY BY FUTURE IMAGES TODAY UNDER 47 C.F.R. 1.1206</u>

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SEP 15 1992

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Respectfully submitted,

FUTURE IMAGES TODAY

By ______________________

Leo Zucker, Attorney
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September 10, 1992

Future Images Today (FIT), through its attorney and pursuant to Section 1.1206 of the Commission's Rules, submits the following <u>ex parte</u> presentation supplementing FIT's Comments filed July 17 and August 17, 1992, in response to the Order/Further Notice of Proposed Rule Making released May 8, 1992.

In its July 17, 1992, Comments, FIT alleged at page 4, paragraph 6 that FIT's predecessor submitted its proposed ATV broadcasting system to the Advisory Committee Chairman in December 1989. The submission consisted of 23 typewritten pages and eight drawing figures, and was excluded from the Third Interim Report of the Advisory Committee to the Commission in March 1990. A complete copy of the proposal, receipt of which was acknowledged by the Committee Chairman by letter dated December 21, 1989 (FIT Comments, July 17, 1992, Exhibit A), follows.

The detailed system submission was never returned to its proponent by the Advisory Committee, nor was it ever presented to the Commission by the Committee as far as is known by FIT.

Two complete copies of this presentation are being mailed this day to the Secretary for inclusion in the above docket.

Respectfully submitted,

Leo Zucker, Attorney
Future Images Today

September 10, 1992

COMPATIBLE AND SPECTRUM EFFICIENT HIGH DEFINITION TELEVISION

A PROPOSAL FOR THE FCC ADVISORY COMMITTEE

ON ADVANCED TELEVISION SERVICE

Richard E. Wiley
Chairman

Proponent:

CAROLE BROADCASTING TECHNOLOGIES, INC.

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December 7, 1989

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<u>GENERAL SYSTEM DESCRIPTION</u> (See Appendix Fig. 1)

The HDTV terrestrial broadcasting system proposed by Carole Broadcasting Technologies, Inc. (CBT) meets current FCC requirements for compatibility with television receivers that operate to reproduce standard definition images, while containing the entire broadcast signal within a six megahertz bandwidth. The system embodies, <u>inter alia</u>, the concept of frequency reuse by which separately modulated electromagnetic waves each having the same carrier frequency but with mutually orthogonal polarizations, can be propagated and received independently via a pair of correspondingly polarized antennas. A high-definition image frame to be broadcast is generated with 1050 horizontal scan lines. Signals corresponding to odd numbered lines are modulated on a first radio frequency carrier to produce a compatible NTSC 525-line interlaced "odd" image frame. Signals corresponding to even numbered lines are modulated on a second carrier having the same frequency as the first, to produce a compatible NTSC 525-line interlaced "even" image frame. The odd and the even image frames are simultaneously radiated from a pair of mutually orthogonally polarized antennas. Reception of HDTV images is implemented with a pair of correspondingly polarized receiving antennas, and the detected odd and even numbered scan lines are properly sequenced to display the original high-definition image frame. The system is also readily adaptable for cable transmission.

BACKGROUND

A. Current ATV Regulation Policy.

On September 1, 1988, the FCC released a Tentative Decision and Further Notice of Inquiry (NOI), FCC 88-288, with respect to an ongoing review of Advanced Television Systems and Their Impact on the Existing Television Broadcast Service (MM Docket No. 87-268). A summary of the NOI is printed in the Federal Register of October 3, 1988, 53 FR 38747-49. As described in the NOI, current state of the art non-broadcast television techniques provide picture resolution and color approaching that obtainable with 35 mm film.

The FCC determined that the public would benefit from a terrestrial broadcast ATV service, but that most systems currently proposed by industry had one or more of the following disadvantages -

1. Non-compatibility with existing color television receivers manufactured according to the United States 30 frame per second, two-field interlaced scan, 525 line NTSC (National Television System Committee) color standard, adopted in 1953.

2. A requirement of more than six megahertz bandwidth for transmission of the entire ATV signal, thus exceeding the

currently allocated terrestrial television broadcast channel bandwidth if the proposed ATV signal is modulated and broadcast on a radio frequency carrier wave.

3. For those proposed ATV systems categorized as compatible with existing receivers, picture resolution is diminished when received on a standard television set, and/or the quality of the picture when reproduced on a "high definition" receiver is degraded during movement of the televised image.

The FCC concluded that any broadcast standards for a new ATV terrestrial service shall be such as to overcome (1) and (2) above. That is, an approved system will be one that is compatible with the many existing color television receivers now in use in the United States so as not to make them suddenly obsolete, and one that will not require additional broadcast frequency allocations to realize maximum picture definition.

The requirement that the existing broadcast television frequency allocations be used for an ATV broadcast service, is dictated both from an administrative and a technical point of view. First, any additional required spectrum might be at the expense of another (non-television) allocated service and would require lengthy hearings to obtain. Second, the additional spectrum might be so far removed in wavelength from existing television channel frequencies on which the "compatible" parts of ATV signals must be broadcast, that differences in propagation characteristics would likely degrade, rather than enhance, the received picture quality.

B. Principles of the Proposed System.

As far as currently known, no system or technique has been proposed that utilizes physical properties of radiated electro-magnetic waves and antenna technology, to enable broadcasting of HDTV signals compatible with existing television receivers and confined within the currently allocated spectrum for the terrestrial broadcast television service.

It is known generally that if mutually orthogonally polarized transverse electromagnetic (TEM) waves, e.g., one horizontally polarized and the other vertically polarized, are transmitted in free space at the same frequency or wavelength, different information modulated on each of the waves can be separately received and demodulated by use of correspondingly polarized receiving antennas. See M. Javid & P. M. Brown, Field Analysis and Electromagnetics, at 294 (McGraw-Hill 1963).

R.C. Johnson and H. Jasik, in their Antenna Engineering Handbook (McGraw-Hill 1984), point out (at page 23-9) that "[f]or any arbitrarily polarized antenna, there can be another antenna polarized so that it will not respond to the wave emanating from the first antenna. The polarizations of the two are said to be orthogonal."

Johnson and Jasik also observe that the deployment of an increasing number of communications satellites has required use of the same frequency to communicate with adjacent areas on the earth. To enable such "frequency reuse", orthogonal polarizations are employed. Orthogonal circularly polarized transmitting and receiving antenna pairs, when used for frequency reuse with communications satellites, are reported to provide channel isolation in excess of 20 dB. Johnson & Jasik, at 23-4.

Current television transmission standards prescribed by the FCC at 47 C.F.R. 73.682 (a)(14) call for horizontal polarization as "standard", but allow circular or elliptical polarization to be employed if desired. In the latter case, the licensed effective radiated power (ERP) of the vertically polarized component may not exceed the licensed ERP of the horizontally polarized component.

FEATURES OF THE PROPOSED SYSTEM

The currently proposed (hereafter "CBT") system provides the following advantages:

1. Full compliance with the mandates of the NOI of September 1, 1988, with respect to a new terrestrial ATV service.

2. Compatibility with all existing receivers manufactured to receive broadcast television signals generated in accordance with current transmission standards as prescribed by the FCC at 47 C.F.R. 73.682.

3. No need to use special converters or other decoding devices with existing receivers in order to permit continuing reception of high definition broadcast television programs.

4. Little, if any, degradation in picture quality when broadcast HDTV signals are received and demodulated by the existing receivers.

5. No requirement of increased channel bandwidth or new spectrum allocations for operation of the CBT system.

6. A requirement for a minimal number of new broadcast standards, thus facilitating regulatory implementation of the CBT system.

7. A system that is "cable ready" in that it is easily adaptable for transmission of HDTV programming to home viewers having suitable receivers over existing cable facilities.

8. An opportunity for certain technologies to advance and new manufacturing methods to evolve, as components of the CBT system are produced to meet consumer demand.

SYSTEM DESCRIPTION

The proposed CBT system is described below with reference to the appendix drawings, Figs. 1-8.

A. Transmitter Configuration.

A video source such as a camera 12 produces 1050 horizontal line signals for each image frame. Through the use of a wobble signal generator or similar known techniques, a scanning electron beam in the camera is caused to deviate periodically in the vertical direction while scanning horizontally. The frequency and amplitude of such deviation is set so that luminance and chrominance information corresponding to picture elements (pixels) of a pair of adjacent lines, is generated simultaneously. That is, of the 1050 horizontal lines scanned for each image frame, information for lines 1 and 2 is simultaneously generated first, then lines 3 and 4, lines 5 and 6, and so on through lines 1049 and 1050.

Information corresponding to the odd line (line 1, line 3, line 5, . . . , line 1049) of each adjacent pair is converted to digital form by analog-to-digital (A/D) converter stage 14, while the line pair is scanned by the camera. Information corresponding to the even line (line 2, line 4, line 6, . . . , line 1050) of each adjacent pair is converted to digital form by A/D converter stage 16, while the line pair is being scanned.

Camera 12, A/D converter stages 14 and 16, and other components of the CBT system are subject to operational timing, synchronization, and control by controller and timing circuitry 18.

Digital information corresponding to luminance and chrominance values for a number of picture elements or pixels along a given odd line, is input to odd line buffer stage 20 when supplied from the output of A/D converter 14, to be stored or latched temporarily in the buffer 20. Likewise, digital information corresponding to luminance and chrominance values for a number of pixels along a given even line, is input to even line buffer 22 stage as supplied from the output of A/D converter 16, to be stored or latched temporarily in the buffer 22. The odd and the even line buffer stages 20, 22 can be known line memory devices, e.g., serial shift registers.

Each odd line of video information latched in the buffer 20 is written into a selected line or row address of odd frame memory stage 24. Similarly, each even line of video information latched in the buffer 22 is written into a selected line or row address of even frame memory stage 26. Each of the odd and the even frame memory stages 24, 26 may be one or more frame memory or storage devices capable of storing luminance and chrominance information for a 525-line video image, in which a predetermined number of picture elements or pixels define each line.

Writing of each odd line of information from the odd line buffer 20 into selected row addresses of the odd frame memory 24, is performed under the control of read/write controller 28 and address select circuit 30 which, in turn, are subject to the control of controller and timing circuitry 18. Writing of each even line of information from the even line buffer 22 into selected row addresses of the even frame memory 26, is accomplished through read/write controller 32 and address select circuit 34 which, in turn, are also subject to control by the controller and timing circuitry 18.

An important feature of the CBT system resides in (1) the manner in which each odd line of video information from odd line buffer 20 is first written into, and then read out from, the odd frame memory 24, and (2) the manner in which each even line of video information from even line buffer 22 is first written into, and then read out from, the even frame memory 26.

Specifically, read/write controller 28 operates so that as each odd line of video information is read out from odd line buffer 20, it is written in odd frame memory 24 at a row address as shown in the memory map of FIG. 5. That is, for odd lines 1, 5, 9, 13, . . . , 1049, the lines are written in "first odd field" row addresses 001 to 263, respectively. For odd lines 3, 7, 11, 15, . . . , 1047, the lines are written in "second odd field" row addresses 264 to 525, respectively, of the memory 24.

Read/write controller 32 is operated such that as each even line of video information is read out from even line buffer 22, it is written in even frame memory 26 at a row address as shown in FIG. 6. Namely, for even lines 2, 6, 10, 14, . . . , 1050, the lines are written into "first even field" row addresses 001 to 263, respectively. For even lines 4, 8, 12, 16, . . . , 1048, the lines are written into corresponding "second even field" row addresses 264 to 525 of frame memory 26.

By selectively reading out the lines of video information as stored in the odd frame memory 24, an NTSC compatible, interlaced 525-line video frame signal is produced. Under the control of controller and timing circuitry 18, the read/write controller 28 successively selects row addresses 001, 002, 003, 004, . . . , 263 from which the video information stored at each row address is read out and input to D/A converter stage 36. Thus, during a first field timing period, the stored "first odd field" is converted into a conventional first field of a 525-line video image frame including all the odd image lines scanned by the camera 12. During a second field timing period, read/write controller 28 successively selects row addresses 264, 265, 266, 267, . . . , 525 of the memory 24, from which video information stored at each row address is read out and input to the D/A converter stage 36. Accordingly, the stored "second odd field" is converted into a conventional second field of the 525 odd line video image frame. The first and the second fields output from D/A converter 36 are applied to a TV modulator 38 which has a radio frequency oscillator 40 that determines the broadcast carrier frequency. TV modulator 38 combines horizontal (H) and vertical (V) synchronization pulses at properly timed intervals with the stream of analog signals output from D/A converter 36. The H and the V pulses are produced by a sync generator 39 which is responsive to the controller and timing circuitry 18.

Further, by reading out lines of video information stored in the even frame memory 26, an NTSC compatible, interlaced 525-line video frame signal is produced for broadcast. During a first field timing period, which may coincide with the one mentioned above, read/write controller 32 successively selects row addresses 001, 002, 003, 004, . . . , 263 from which video information stored at each row address is read out and input to D/A converter stage 42. The stored "first even field" is thus converted into a conventional first field of a 525-line video image frame including all the even image lines scanned by camera source 12. During a second field timing period (which may also coincide with the one above-mentioned), read/write controller 32 successively selects row addresses 264, 265, 266, 267, . . . , 525 of frame memory 26, from which video information stored at each row address is read out and applied to D/A converter stage 42. As a result, the stored "second even field" is converted into a conventional second field of the 525 even line video image frame. The first and second fields output from D/A converter 42 are applied to TV modulator 44 which is preferably of the same construction as TV modulator 38, and derives its broadcast carrier frequency from the common RF oscillator source 40. TV modulator 44 combines the H and the V synchronization pulses produced by sync generator 39, in correctly timed relation with the analog signals output from D/A converter 42.

The output of TV modulator 38 drives RF amplifier 46, and the output of TV modulator 44 is supplied to drive RF amplifier 48. RF amplifiers 46 and 48 may be conventional units, preferably of identical construction.

RF amplifier 46 is connected through transmission line 50 to excite antenna 52, and RF amplifier 48 has its output fed through transmission line 54 to drive antenna 56. Antennas 52 and 56 may have similar configurations and gain, but must have mutually orthogonal polarizations. For example, if antenna 52 is linearly horizontally polarized, antenna 56 must be linearly vertically polarized, or vice versa. Alternatively, antenna 52 can be circularly or elliptically polarized in a first sense of rotation, while antenna 56 is circularly or elliptically polarized in a second sense of rotation opposite to the first sense.

Antennas 52 and 56 can be located together at a common transmitting site, in which case it is preferred that known techniques for minimizing inter-element coupling between the two antennas 52, 56 be implemented.

A television signal broadcast from the antennas 52, 56 can, as shown in FIG. 2, be received and viewed with a standard NTSC receiver 60. A receiving antenna 62 for the receiver 60 may have a polarization corresponding directly to one of the transmitting antennas 52, 56, e.g., polarization A corresponding to transmitting antenna 52. Alternatively, an orthogonally polarized receiving antenna 62' having polarization B corresponding to transmitting antenna 56, can be used for the receiver 60.

Accordingly, when using receiving antenna 62, the conventional NTSC receiver 60 will reproduce the interlaced 525-line "odd" video image frames that are output from the modulator 38, amplified by RF amplifier 46 and radiated from antenna 52.

With receiving antenna 62', receiver 60 will reproduce the interlaced, 525-line "even" video image frames that are output from the modulator 44, amplified by RF amplifier 48 and radiated from antenna 56.

If the transmitting antennas 52, 56 are relatively closely situated to one another, adjacent lines of the NTSC video signals as modulated on the respective transmitted RF carrier waves, will be propagated substantially in phase as represented in FIG. 3.

B. Receiving Set Configuration.

FIG. 4 is a schematic block diagram of a proposed HDTV receiving system.

A dual polarization receiving antenna array includes antennas 102 and 104. Antenna 102 is polarized to match the polarization A of transmitting antenna 52, while antenna 104 is of the orthogonal polarization B to match that of transmitting antenna 56. Antennas 102, 104 can be located relatively close to one another at a common receiving site. In such case, known decoupling techniques should be employed to minimize inter-element coupling between the two antennas 102, 104.

Lead-in transmission lines or cables 106, 108 are connected between the antennas 102, 104 and respective tuner/demodulator systems 110, 112. The cables 106, 108 should be shielded or otherwise electrically isolated from one another. Systems 110, 112 may each include radio frequency (RF) amplifier, mixer, intermediate frequency (IF) and video detector stages. A common local oscillator stage 114 should be provided to ensure common frequency tracking by both of the tuner/demodulator systems 110, 112.

Signals output from system 110 include the odd lines of eacn 1050 line image scanned by camera source 12 of the transmitting system 10, as broadcast on a first carrier wave of polarization A. The signals output from system 112 include the even lines of each 1050 line image scanned by the camera source 12, as broadcast on a second carrier wave of polarization B but having the same frequency as the first carrier wave. The signals output from the tuner/demodulator systems 110, 112 may be in the form of separate luminance and chrominance signals corresponding to the image lines detected from each of the broadcast carrier waves.

After separation of the horizontal and vertical synchronization pulses from the detected video signals by sync separator 115, output signals from tuner/demodulator system 110 are input to A/D converter stage 116, and the signals produced by system 112 are input to A/D converter stage 118. A/D converter stages 116, 118 and other processing components of the receiving system are subject to control by controller and timing circuitry 120 which, in turn, includes circuits for generating operational timing and clock signals that track the phase of the separated synchronization pulses.

Successive ones of the demodulated odd line video signals are output from A/D converter 116 and entered for temporary storage in odd line buffer or latch 122. Similarly, the demodulated even line video signals are successively output from A/D converter 118 and held in even line buffer 124. Buffers 122, 124 can be known line memory devices.

Each odd line of video information latched in the buffer 122 is written into a selected row address of odd frame memory stage 126. Similarly, each even line of video information latched in the buffer 124 is written into a selected row address of even frame memory stage 128. The odd and the even frame memory stages 126, 128 each may include one or more frame memory or storage devices capable of storing luminance and chrominance information for a 525-line video image, wherein a predetermined number of picture elements or pixels define each line.

Writing of each odd line of information from the odd line buffer 122 into selected row addresses of the odd frame memory 126, is performed under the control of address select circuit 130 and read/write controller 132 which, in turn, are subject to the control of controller and timing circuitry 120. Writing of each even line of information from the even line buffer 124 into selected row addresses of the even frame memory 128, is accomplished through write address select circuit 134 and read/write controller 136 which, in turn, are also subject to control by the controller and timing circuitry 120.

FIGS. 7 and 8 are memory maps representing address storage locations in the frame memories 126, 128, respectively.

Recall that the output of the tuner/demodulator system 110 and, thus, the output of A/D converter 116, corresponds to an interlaced 525-line video frame includes all odd lines of the 1050 lines scanned by camera 12 in the transmitting system. The line number order of the video information signals output from A/D converter 116 is, therefore, line 1, line 5, line 9, line 11, . . . , line 1049, which define the "first odd field". Next, signals representing lines 3, 7, 11, 15, . . . , 1047, are produced from A/D converter 116. In order to obtain all the odd lines of the 1050 lines scanned by camera 12 in successive order, read/write controller 132 and address select circuit 130 operate to write each line of video information as output from odd line buffer 122 in row address locations of the odd frame memory 126, according to the memory map of FIG. 7.

Specifically, during a first odd field time period, video information corresponding to line 1 is written in row address 001, line 5 in address 003, line 9 in address 005, . . . , line 1049 in address 525. That is, during the first odd field time period, the video line information is written in successive odd row addresses of frame memory 126, as output from buffer 122.

During a second odd field time period, video information corresponding to line 3 is written in row address 002, line 7 in address 004, line 11 in address 006, . . . , line 1047 in address 524. Accordingly, during the second odd field time period, the video information is written in successive even row addresses of frame memory 126, as output from buffer 122.

The 525-line video information thus stored in odd frame memory 126 forms, as shown in FIG. 7, consecutive odd numbered lines of a 1050 line image frame to be reproduced by the receiving system.

Likewise, it will be recalled that the output of the tuner/demodulator system 112 and, thus, the output of A/D converter 118, corresponds to an interlaced 525-line video frame comprised of all even lines of the 1050 lines scanned by camera 12 in the transmitting system 10. The line number order of the video information signals output from A/D converter 118 is,